

Mobility and Node Density Based Performance Analysis of AODV Protocol for Adhoc Network using ns-2

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Abstract- A mobile ad-hoc network (MANET) is a collection of mobile nodes, which communicate over radio. These networks have an important advantage; they do not require any existing infrastructure or central administration. Therefore, mobile ad-hoc networks are suitable for temporary communication links. This flexibility, however, comes at a price: communication is difficult to organize due to frequent topology changes. In this paper we propose on-demand routing algorithm for mobile, multi-hop ad-hoc networks. The algorithm is based on ant algorithms, which are a class of swarm intelligence. The main goal in the design of the algorithm is to reduce the overhead for routing. Furthermore, in this paper the performance of AODV protocol is analyzed by varying mobility and node density parameters through simulation of results ns2 simulator.

Keywords- Adhoc networks, AODV, routing protocols, route maintenance, simulation, performance evaluation, swarm intelligence.

I. INTRODUCTION

A mobile multi-hop ad-hoc network (MANET) is a set of mobile nodes which communicate over radio and do not need any infrastructure. These networks are very flexible and suitable for several types of applications, as they allow the establishment of temporary communication without any pre installed infrastructure. Due to the limited transmission range of wireless interfaces, in most cases communication has to be relayed over intermediate nodes. Thus, in mobile multi-hop ad-hoc networks each node also has to be a router. Beside the disaster and military application domain the deployment of mobile ad-hoc networks for multimedia applications is another interesting domain. With newly emerging radio technologies, e.g. IEEE 802.11a and Bluetooth, the realization of multimedia applications over mobile ad-hoc networks becomes more realistic. To find a route between the communication end-points is a major problem in mobile multi hop ad-hoc networks. The problem is further aggravated through the node mobility. Many different approaches to handle this problem have i.e. the address of the node from which the message was received. A lifetime is associated with each reverse route entry, i.e. if the route entry is not used within the lifetime it will be removed. The second phase of the protocol is called

been reported, but so far no routing algorithm has been suitable for all situations. Other aspects of mobile ad-hoc networks are also subject to current research, especially the dynamic address configuration of nodes.

In this paper an approach is proposed for an on-demand ad-hoc routing algorithm, which is based on *swarm intelligence and parametric analysis* has been proposed. At the end, algorithm is tested for mobile multi-hop adhoc networks in ns-2 environment for its performance.

II. ROUTING PROTOCOLS IN MANET

The Ad-Hoc On-demand Distance Vector (AODV) [1] routing protocol is one of several published routing protocols e.g. Dynamic Source Routing (DSR) [3][4], Destination-Sequenced Distance Vector (DSDV)[5] etc. for mobile ad-hoc networking. Wireless ad-hoc routing protocols such as AODV are currently an area of much research among the networking community

A. Ad Hoc On-Demand Distance-Vector Protocol (AODV)

The Ad Hoc On-Demand Distance-Vector Protocol (AODV) is a distance vector routing for mobile ad-hoc networks. AODV is an on-demand routing approach, i.e. there are no periodical exchanges of routing information.

The protocol consists of two phases

- i) Route Discovery
- ii) Route Maintenance.

A node wishing to communicate with another node first seeks for a route in its routing table. If it finds path, the communication starts immediately, otherwise the node initiates a *route discovery* phase. The route discovery process consists of a route-request message (RREQ) which is broadcasted. If a node has a valid route to the destination, it replies to the route-request with a route-reply (RREP) message. Additionally, the replying node creates a so called *reverse route* entry in its routing table, which contains the address of the source node, the number of hops to the source, and the next hop's address, *route maintenance*. It is performed by the source node and can be subdivided into: i) source node moves: source node initiates a new route discovery process, ii) destination or an intermediate node moves: a route error message (RERR) is

sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages, which are small RREP packets containing a node's address and additional information

B. The Basic Protocol

Each AODV router is essentially a state machine that processes incoming requests from the SWANS network entity. When the network entity needs to send a message to another node, it calls upon AODV to determine the next-hop.

Whenever an AODV router receives a request to send a message, it checks its *routing table* to see if a route exists. Each routing table entry consists of the following fields:

- Destination address
- □ Next hop address
- □ Destination sequence number
- □ Hop count

If a route exists, the router simply forwards the message to the next hop. Otherwise, it saves the message in a *message queue*, and then it initiates a route request to determine a route. The flow chart as shown in fig. 1 illustrates this process:

Upon receipt of the routing information, it updates its routing table and sends the queued message(s). AODV nodes use four types of messages to communicate among each other. *Route Request (RREQ)* and *Route Reply (RREP)* messages are used for route discovery. *Route Error (RERR)* messages and *HELLO* messages are used for route maintenance.

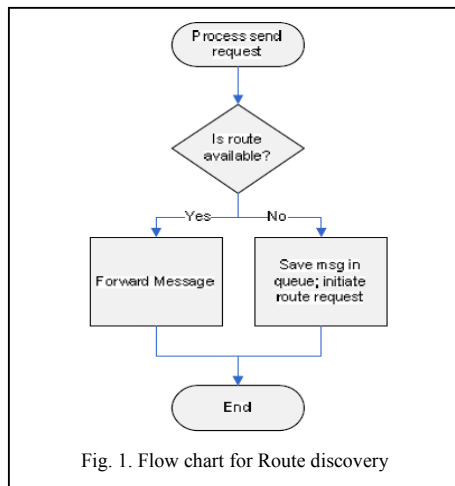


Fig. 1. Flow chart for Route discovery

C. Related Code

Some main Variable and Data Structures with description

- seqNum (int)–The node's sequence number. It is initialized to SEQUENCE_NUMBER_START

and is incremented just before broadcasting a RREQ message.

- RouteTableEntry – This class represents the route information for some destination. It includes: a next hop address (MacAddress), a destination sequence number, and a hop count.
- □rrreqList (LinkedList) – This structure contains a list of pending route requests (of type RouteRequest) originated by the node. Routes requests (represented as RouteRequest objects) are added to this list
- RreqBufferEntry – This class contains the RREQ ID and address of the node that originated the RREQ. It also contains the time (simulation time) that the message was sent.
- outgoingSet(OutgoingSet)–This stores a list of outgoing nodes, along with a helloWaitCount for each outgoing node. helloWaitCount keeps track of the number of HELLO_INTERVALs that have passed since the last message was received from outgoing node.
- □rrreqIdSeqNum (int) – The sequence number for RREQ ID's. When sending a RREQ message, it assigns rrreqIdSeqNum to the message's rrreqId field, and then increments rrreqIdSeqNum.

D. Related Core Methods with brief description

send(NetMessage()) – This method, called by the network entity, attempts to send a message over the network. If routing information is available, it simply forwards the message to the appropriate next hop. Otherwise, the message is saved in the messageQueue and a route request is originated.

receive(...) – This method, called by the network entity, processes incoming AODV messages. It checks the type of the message object and passes the message to the appropriate method e.g.

receiveRouteReplyMessage() – Processes an incoming RREP message. Updates routing tables and outgoing lists. Then, if the node is the RREQ originator, it removes the pending route request, and sends the queued messages along the new route. If the node is not the RREQ originator, it forwards the RREP to the next hop.

receiveRouteErrorMessage() – Processes an incoming RERR message. Removes all affected routes. If even one route is removed, it calls precursorSet.sendRERR() to forward the RERR to all precursors.

receiveHelloMessage() – Processes an incoming HELLO message. The peek() method takes care of the processing of HELLO messages.

E. AODV Message Classes

Following four classes represent the different AODV messages. Each implements Message interface.

- RouteRequestMessage
- RouteReplyMessage
- RouteErrorMessage
- HelloMessage

III. RESULTS

The important performance metrics which were evaluated in this paper are:

Packet delivery ratio: The ratio of data packets delivered to the destination to those generated by cbr sources.

Normalized Routing Load: The number of routing packets transmitted per data packet delivered at the destination. Each hop wise transmission of a routing packet is counted as one transmission.

These parameters are evaluated on the basis of varying mobility and varying node density.

Effect of Varying Node Density: In the proposed algorithm the simulation is carried out by varying the number of nodes from 10 to 50 and results are evaluated by comparing with the standard result for that variation. In case of packet delivery ratio as the number of nodes increases the packet delivery ratio increases (fig.2).

Effect of Varying Mobility: In our simulation we have varied the speed of nodes from 0 to 20(m/sec) with keeping number of nodes constant.

In the presence of high mobility, link failure can happen very frequently. It triggers new route discoveries as it has almost one route per destination in its routing table and so the occurrences of route discoveries in AODV are directly proportional to the number of route breaks.

So on varying the speed of nodes the packet delivery ratio will decrease (fig 3) because on increasing the speed the link between source and destination will break frequently. The normalized routing overhead also increases as the mobility becomes more than 10 (fig. 6).

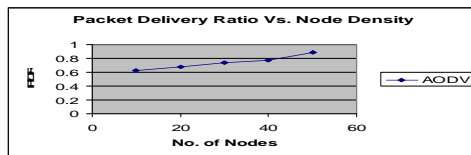


Fig. 2 Packet Delivery Ratio Vs Node Density

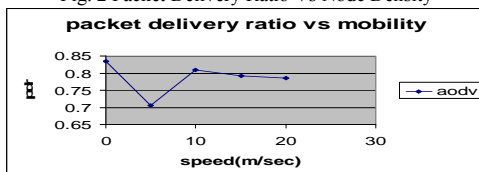


Fig.3 Packet Delivery Ratio Vs Mobility

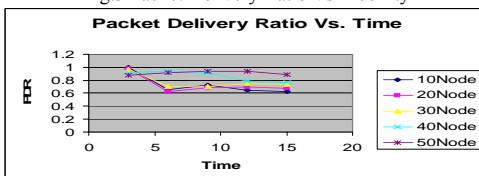


Fig 4. Packet Delivery Ratio Vs Time

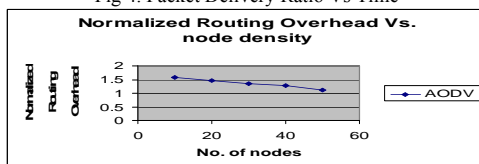


Fig5. Normalized Routing Overhead Vs Node Density

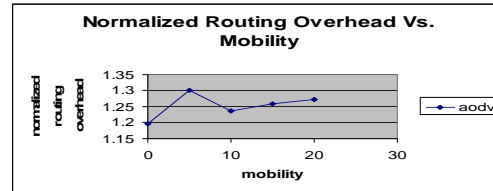


Fig 6. Normalized Routing Overhead Vs Mobility

IV. CONCLUSION

Figures shown above display the parametric analysis of AODV routing protocol over the varying mobility and node density.

AODV performs better under low mobility and high node density. As we have seen in fig.2-6, the effects of different parameters with the variation of node density and mobility.

Variation of node density: As the number of nodes increases, the nodes behaving as intermediate nodes also increase and so the neighbor discovering time minimizes. This results in quicker path finding. So we obtain the better packet delivery ratio from source to destination (fig.2). As node density increases, the normalized routing load also decreases (fig 5). With time, packet delivery stabilizes as mostly routes are discovered and less route discoveries are required (fig. 4).

Variation of node mobility: As the speed of nodes increases, the link failure between the source and destination occurs frequently. This will result in low packet delivery ratio (fig 3), high normalized routing load (fig 6).

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